CLAIMS

We claim:

1. An IgE-CH3 domain antigen peptide between about 25 and about 29 amino acids in length containing two cysteine residues separated by about 23 amino acid residues, selected from the group consisting of SEQ ID NO:5, SEQ ID NO:6, SEQ ID NO:7, SEQ ID NO:8, SEQ ID NO:84, homologous sequences from the epsilon heavy chain of mammalian IgE-CH3, and crossreactive and immunologically functional analogs thereof.

2. An IgE-CH3 domain antigen peptide of claim 1 selected from the group consisting of SEQ ID NO:5, SEQ ID NO:6, SEQ ID NO:7, SEQ ID NO:8, and SEQ ID NO:84.

3. A synthetic peptide of about 50 to about 90 amino acids, which comprises

    (a)   a helper T cell (Th) epitope,

    (b)   an IgE-CH3 domain antigen peptide according to claim 1;and

    (c)   an immunostimulatory invasin domain.

4. A peptide conjugate comprising a helper T cell epitope sequence (Th) covalently attached to an IgE-CH3 domain antigen peptide according to claim 1.

5. A peptide conjugate represented by the formula

$$(A)_n-(IgE\text{-}CH3 \text{ domain antigen})-(B)_o-(Th)_m-X$$

or

$$(A)_n-(Th)_m-(B)_o-(IgE\text{-}CH3 \text{ domain antigen})-X$$

wherein

each A is independently an amino acid or a general immunostimulatory sequence;

each B is chosen from the group consisting of amino acids, $-NHCH(X)CH_2SCH_2CO-$, $-NHCH(X)CH_2SCH_2CO(\varepsilon\text{-}N)Lys-$,

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-NHCH(X)CH$_2$S-succinimidyl(ϵ-N)Lys-, and -NHCH(X)CH$_2$S-(succinimidyl)-;

each Th is independently a sequence of amino acids that constitutes a helper T cell epitope, or an immune enhancing analog or segment thereof;

IgE-CH3 domain antigen represents the sequence of an IgE-CH3 domain antigen peptide according to claim 1;

X is an amino acid α-COOH or α-CONH$_2$;

n is from 0 to about 10;

m is from 1 to about 4; and

o is from 0 to about 10.

6.   A peptide conjugate represented by the formula

(IgE-CH3 domain antigen)-(B)$_o$-(Th)$_m$-(A)$_n$-X

or

(Th)$_m$-(B)$_o$-(IgE-CH3 domain antigen)-(A)$_n$-X

wherein

each A is independently an amino acid or a general immunostimulatory sequence;

each B is chosen from the group consisting of amino acids, -NHCH(X)CH$_2$SCH$_2$CO-, -NHCH(X)CH$_2$SCH$_2$CO(ϵ-N)Lys-, -NHCH(X)CH$_2$S-succinimidyl(ϵ-N)Lys-, and -NHCH(X)CH$_2$S-(succinimidyl)-;

each Th is independently a sequence of amino acids that constitutes a helper T cell epitope, or an immune enhancing analog or segment thereof;

IgE-CH3 domain antigen represents the sequence of an IgE-CH3 domain antigen peptide according to claim 1;

X is an amino acid α-COOH or α-CONH$_2$;

n is from 0 to about 10;

m is from 1 to about 4; and

o is from 0 to about 10.

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7. A peptide conjugate of any one of claims 4-6 wherein said Th is an SSAL.

8. A peptide conjugate of any one of claims 4-6 wherein said IgE-CH3 domain antigen peptide has an amino acid sequence selected from the group consisting of SEQ ID NO:5, SEQ ID NO:6, SEQ ID NO:7, SEQ ID NO:8, and SEQ ID NO:84.

9. A peptide conjugate of claim 7 wherein said IgE-CH3 domain antigen peptide has an amino acid sequence selected from the group consisting of SEQ ID NO:5, SEQ ID NO:6, SEQ ID NO:7, SEQ ID NO:8, and SEQ ID NO:84.

10. A peptide conjugate of any one of claims 4-6 wherein said Th has an amino acid sequence selected from the group consisting of SEQ ID NOS: 9-12 and SEQ ID NOS: 61-82 and 84.

11. A peptide conjugate of claim 7 wherein said Th has an amino acid sequence selected from the group consisting of SEQ ID NOS: 9-12 and SEQ ID NOS: 61-82 and 84.

12. A peptide conjugate of claim 8 wherein said Th has an amino acid sequence selected from the group consisting of SEQ ID NOS: 9-12 and SEQ ID NOS: 61-82 and 84.

13. A peptide conjugate of claim 9 wherein said Th has an amino acid sequence selected from the group consisting of SEQ ID NOS: 9-12 and SEQ ID NOS: 61-82 and 84.

14. A peptide comprising an amino acid sequence selected from the group consisting of SEQ ID NOS: 14, 15, 17-27, 85, 87, 88, 90, 91.

15. A peptide conjugate of claim 5 or 6, wherein at least one A is an invasin domain.

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16. A peptide conjugate of claim 5 or 6 wherein n is 3, and $(A)_3$ is (invasin domain)-Gly-Gly.

17. A peptide conjugate of claim 15 wherein said invasin domain has the amino acid sequence of SEQ ID NO:13.

18. A peptide conjugate of claim 16 wherein said invasin domain has the amino acid sequence of SEQ ID NO:13.

19. A peptide conjugate comprising a carrier protein covalently attached to one or more IgE-CH3 domain antigen peptides according to claim 1.

20. The peptide conjugate of claim 19 wherein the carrier protein is keyhole limpet hemocyanin.

21. A peptide comprising an amino acid sequence selected from the group consisting of SEQ ID NOS:14, 15, 26, 90.

22. A branched polymer comprising a lysine, trilysine, or heptalysine core, covalently attached to two, four, or eight peptide conjugates, respectively, of any one of claims 4-6 or 14.

23. A polymer comprising one or more peptide conjugates of any one of claims 4-6 or 14, cross-linked by a bifunctional crosslinking agent.

24. A pharmaceutical composition comprising an immunologically effective amount of a peptide or peptide conjugate of any one of claims 4-6 or 14, and a pharmaceutically acceptable carrier.

25. A pharmaceutical composition of claim 23, wherein said immunologically effective amount of said peptide or peptide conjugate is between about 0.5 μg and about 1 mg per kilogram body weight per dose.

26. A method for inducing anti-IgE antibody production in a mammal which comprises administering to said mammal a pharmaceutical composition of claim 23.

27. A method for inducing anti-IgE antibody production in a mammal which comprises administering to said mammal a pharmaceutical composition of claim 24.

28. A nucleic acid comprising a sequence which encodes a peptide of any one of claims 1-6.